

MSE 6110 – Transmission Electron Microscopy
Spring SEMESTER 2018

Instructor: Josh Kacher
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Office hours: Monday 11-12 am (directly after class)
Thursday 9-10 am
Or email and set up a time

Textbook: Primary textbook will be Transmission Electron Microscopy, by D. B. Williams and C.B. Carter
Additional textbooks that may be useful:
Physical Principles of Electron Microscopy, R.F. Egerton, Springer, 2010
Transmission Electron Microscopy and Diffractometry of Materials, B. Fultz and J.M. Howe, Springer 2008

(free electronic copies available through GT from www.springer.com)

Useful websites:
<http://emaps.mrl.uiuc.edu/> - for generating simulated diffraction patterns

Final Exam: Wednesday, May 2 8-10:50 AM

Grading: The following components will make up your final grade.

Weekly quiz	15%
Homework	15%
Class project	30%
Midterm exam	20%
Final exam	20%

Assignments/quizzes:

Problem sets will be assigned periodically over the course of the semester. Assignments will be made at least one week prior to the due date. Quizzes will be held weekly at the beginning of class on Wednesdays. The quizzes will be projected on the overhead and completed on paper. Each student is required to bring paper and a writing utensil to class on Wednesdays. Lowest quiz score will be dropped. Any missed quizzes will count as a zero on your grade unless excused ahead of time.

Grading Scheme (Grading will be no tougher than this):

A 90-100 B 80- 89.9 C 70-79.9 D 60-69.9

Learning Outcomes:

By the end of the course, the student should have an understanding of the basic components which make up a transmission electron microscope as well as a fundamental understanding of the theory behind electron scattering and different imaging modes. The student will have a theoretical knowledge of how to conduct basic characterization of materials, including their atomic structure and defect state, with some hands on experience.

Topics Covered:

1. Basic principles of electron interactions with atoms
2. TEM hardware
3. Specimen preparation
4. Electron diffraction
5. TEM imaging (bright-field, dark-field, phase contrast, STEM)
6. Contrast analysis of defects

Tentative lecture schedule (dates will almost definitely change!!!)

Lecture	Date	Topic	Reading (W&C)	Assignment due
1	1/8	Introduction	1	
2	1/10	Scattering and diffraction basics	2,3,4	
3	1/12	Scattering and diffraction basics	2,3,4	
MLK Day	1/15			
4	1/17	Scattering and diffraction basics	2,3,4	
5	1/19	Sample preparation and beam damage	10	
6	1/22	The TEM	5-9	
7	1/24	The TEM	5-9	
8	1/26	The TEM	5-9	Project proposal
9	1/29	The TEM	5-9	
10	1/31	The TEM	5-9	
11	2/2	The TEM	5-9	
12	2/5	Electron diffraction	11-12	
13	2/7	Electron diffraction	11-12	
14	2/9	Electron diffraction	13, 16	
15	2/12	Electron diffraction	17-19	
16	2/14	Electron diffraction	17-19	
17	2/16	Electron diffraction	20-21	
18	2/19	BF/DF/WBDF imaging + Exam review	22, 23, 26	
19	2/21			Midterm Exam
20	2/23	BF/DF/WBDF imaging	22, 23, 26	
21	2/26	BF/DF/WBDF imaging	22, 23, 26	
22	2/28	BF/DF/WBDF imaging	22, 23, 26	
23	3/2	Contrast analysis of defects	24-26	
24	3/5	Contrast analysis of defects	24-26	Midterm report
25	3/7	Contrast analysis of defects	24-26	

26	3/9		24-26	
27	3/12	STEM/ Aberration correction	24-26	Jane Howe guest lecture
28	3/14	STEM/ Aberration correction	24-26	Jane Howe guest lecture
29	3/16	STEM/ Aberration correction	27-28	Jane Howe guest lecture
Spring Break	3/19			
Spring Break	3/21			
Spring Break	3/23			
30	3/26	Phase contrast	27-28	
31	3/28	Phase contrast	27-28	
32	3/30	Phase contrast	27-28	
33	4/2	Image simulation	30	
34	4/4	Image simulation	30	
35	4/6	Image analysis	31	
36	4/9	X-ray analysis	32-36	
37	4/11	X-ray analysis	32-36	
38	4/13	EELS	37-39	
39	4/16	EELS	37-39	
40	4/18	Special topics		
41	4/20	Special topics		
42	4/23	Review		Final Project due

Missed Tests: *Unexcused* – A grade of zero will be given for all unexcused missed tests.

Excused – Student must contact instructor *before* a test is missed. Exceptions may be made in special circumstances.

T-square: T-Square will be used in this class for providing you course information (see Resources). Homework will be assigned in class and posted on T-square.

Homework: Homework can be done in groups but each student must submit her/his own work.

Tests and Exams: All quizzes and exams will be closed book and notes, but some equations and tables will be provided as needed. However, **basic equations will not be provided.** This will be clarified as material is covered.

Academic Honor Code:

Compliance with Georgia Tech's Academic Honor Code is required.

Please read and understand this document (if you have not already done so). Per the Georgia Tech Honor Code Website <http://honor.gatech.edu/content/2/the-honor-code>

Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own: use (another's production) without crediting the source." If caught plagiarizing, you will be dealt with according to the GT Academic Honor Code.

For appointments, please come by during office hours or email to arrange a different time.